Board 118: Mixing it Up: A Pilot Study on the Experiences of Mixed-Race Asian-American Students in Engineering

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Introduction

Engineering Education Research (EER) has approached the category of mixed-race students as a precarious population within engineering. Due to the various selections available in demographic data, mixed-race students are often not counted in the numbers and resources available for students with minoritized identities [1]. Therefore, these students may be left behind or 'invisibilized' within engineering education. In particular, Asian American mixed-race students are challenged by the "Model Minority Myth" which intersects with their other non-Asian American racial/ethnic identity they hold. Asian American mixed-race students navigate a unique path in engineering due to their intersectional identities along with their other cultural and professional identities. Thus, we ask the following research question: What does it mean to be a mixed-race Asian American in engineering?

The purpose of this pilot study is to develop a foundation for a larger study on the experiences of mixed-race Asian American students in undergraduate engineering. In qualitative studies, pilot studies are utilized to develop more complex research studies for guiding research directions. Pilot studies can help qualitative researchers face unanticipated and incidental challenges early in the research process. Some of these challenges can: help refine research tools such as research questions and frameworks, create a flexible and iterative research design process, minimize researcher bias, and serve as indispensable gateways to unknown research spaces [2]. Reflecting on the design process through this pilot study can help narrow down specific questions, frameworks, and design choices.

In this pilot study, the leading author interviewed six mixed-race Asian American students enrolled in undergraduate engineering to understand how they made sense of their identities (Asian American, mixed-race, and engineering). We were interested in understanding their experiences navigating engineering while being mixed-race Asian American students. We aim to use this study to achieve certain goals: (1) acquiring some general knowledge of mixed-race identity factors salient to students (due to the lack of research on mixed race students in general in engineering education); (2) experimenting with interview questions and refining them for later research; and (3) exploring what theoretical frameworks are viable for this research.
At this stage, we want to explore the feasibility of applying either Critical Multiracial Theory (MultiCrit) or Asian Critical Theory (AsianCrit) and evaluate to what extent and in what sense it could fit the goals of our research. MultiCrit is guided by Critical Race Theory (CRT) to include mixed-race students as a population whose intersectional identities are often not considered in higher education [3]. While MultiCrit was developed for use in Higher Education, it has not been utilized empirically in Engineering Education Research as a theoretical framework. This work aims to add to larger discussions in the Engineering Education community regarding truly inclusive spaces for all underserved students.

In our previous work [4], we introduced the theoretical framework of MultiCrit as an addition to the family of critical race frameworks that the field of engineering education research could utilize. While that paper aims to lay the groundwork for MultiCrit to be utilized by engineering education researchers, we aim to put MultiCrit into practice and observe the feasibility of its use and implementation in a pilot study, for a larger study.

For the purposes of this study, we want to clearly define what we refer to when saying mixed-race. Throughout this paper, the following terms refer to a person who identify with more than two races: mixed-race, multiracial, and two or more races [4,5]. In particular, biracial refer to a person who only identifies with two racial identities [6]. Often in Science, Technology, Engineering, and Math (STEM) related research, mixed-race is often a category left out [5]. Due to our focus of utilizing MultiCrit as a framework, we focus primarily on mixed-race through the US context. However we do include a participant who is of mixed-race Asian identity but is an international student. We decided to include this participant as it is important to showcase that mixed-race experiences are not just specific to the US but occur internationally as well.

Relevant Literature

Mixed-Race in Higher Education

As a topic within the research field of education, scholars have previously tried to understand the dynamics of mixed-race identity in relation to higher education. Emerging from psychology, scholars have looked into the identity development of mixed-race individuals. Positive multiracial identity development, posed by Maria Root, views biracial identity development differently from monoracial experiences, offering four ways of resolving tensions of biracial identity: accepting the identity society assigns; identifying with both racial groups; identifying with a single racial group; and identifying with a new racial group, identifying mostly as biracial or mixed-race [6,7]. This framework views how one may have multiple self-identities which can be fluid over time.

Renn's Ecological Model of Mixed Race Identity Development focuses on the ecological environment of the college/university setting, which can be a space where students explore their identity [1]. This approach looked at identity development from Bronfenbrenner's PPCT framework: person, process, context, and time. However, it is important to note that Renn's model examines one's identity at a particular time [1]. Renn's work also indicates that there are multiple ways mixed-race students navigate and self-identify regarding their racial and ethnic identities.

Within specifically STEM education, researchers have noted how mixed-race individuals are excluded or failed to be recognized in relation to research on minority students in STEM [5]. In the field of Engineering Education, one empirical study analyzed the experiences of mixed-race Native American students. It is important to note that the mixed-race identity of the students was not the focus of the larger study but happened by chance [8]. The failure of previous research to

recognize these students in the larger body of STEM student experiences is in part one of the major reasons for pursuing this project.

Pilot Studies in Qualitative Research

In order to get a baseline and rough draft of developing a research design for a larger project, the graduate student, first author, developed a pilot study. Pilot studies have been useful for qualitative researchers to develop and refine a study's research design, conceptualize the research topic, and interpret the findings and results [2,9]. Researchers have discussed the underutilized nature of pilot studies and how they can help foreshadow research gaps and problems [2]. Creswell and Creswell suggest utilizing pilot testing to refine questions and procedures during the interview process [10]. Ismail et al. identify two major reasons as to why quantitative research utilizes pilot studies more than qualitative research [11]. First, pilot studies often use valuable resources including time, money, space, and energy [11,12]. The second focuses on the flexible nature of qualitative research, in that the researcher should be able to spontaneously refine questions, data collection and analysis if they can foresee the roadblocks along the way [10,11].

The pilot study is the first step in the entire research process and is often *exploratory* by nature. Nevertheless, it is also often a neglected part of the research process. Systematic discussions on the purposes, methods, and evaluations for the pilot study are insufficient in the literature, especially in the context of qualitative studies [13]. In general, a pilot study often serves two major purposes. The first is to find potential problems in recruiting participants. Second, conducting pilot studies can help researchers develop and iterate the questions included in an interview protocol [2, 14].

To develop a consensus on how many participants we wanted to use for this study, we utilized Malterud et al.'s concept of information power (see Figure 1) [15]. Information power helped us analyze the sample pool from which we had to develop this study methodologically. According to Malterud et al., information power explains that fewer participants are needed if the sample holds more information important to the study [15]. Five aspects are important to determining the information power of a specific sample: study aim, sample specificity, established theory, dialogue quality, and analysis strategy. More comprehensive and sufficient information power can be obtained if a study is more focused and narrower. Students who carry a specific demographic and are highly specific for a study also contribute to a higher information power. Studies that use a limited or no theoretical perspective typically require a larger sample to establish synthesis across existing knowledge obtained through the interviews. Communication is also key to the quality of an interview's dialogue. Having interviewers who share similar backgrounds to the students helps build quicker repertoire with the interviewee and can help delve at nuances with these students' experiences that aren't relatively public knowledge.

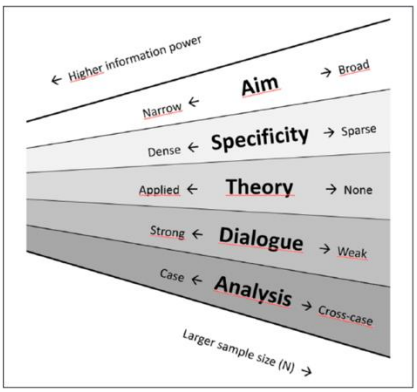

Figure 1. Information power—Items and dimensions.

Methods

Guiding our research process, we ask the following research question: What does it mean to be a mixed-race Asian American student in engineering? In order to answer this question in depth, we turned to qualitative methods as it allows for students to share their experiences for what it means to be mixed-race Asian American in engineering. As we are testing out the specifics of this project, we utilized a pilot study. Our purposes for conducting a pilot study were threefold. First, we wanted to explore which interview questions are needed for our interview protocol. In order for us to be better equipped to dive into the world of these students, we need to be able explore these questions in detail. Second, putting out a call and interviewing students helped us view an example population demographic. While colleges and universities collect racial demographics, it is often difficult to find the disaggregated demographic of Asian American mixed-race students as the two or more category is often included into the "Other" category. Therefore, there is no clear disaggregation of the students comprised in the two or more category. Third, running this pilot study also helped justify the need for further research regarding mixed-race students in engineering. Due to the pilot and exploratory nature of this study, we utilized purposive and convenient sampling methods. Convenience sampling allowed us to find participants more accessible for us on campus and is suitable for pilot studies [17,18].

For this initial study, we used qualitative methods to further understand and explore the experiences of our student participants. Qualitative research allows for our findings to be applicable to other settings through utilizing thick description [16]. This study was approved by the university's Institutional Review Board for Human Subjects Research (IRB 23-1292). Students were selected for participation from the university, which is a public Asian American, Native American and Pacific Islander Serving Institution (AANAPISI). This university was chosen as it holds the AANAPISI designation, indicating that at least 10% of its total full-time undergraduate student population identifies as Asian American and at least 50% of the student population receive need-based assistance as outlined by Pell grant eligibility [19].

We decided to aim for five student participant interviews, as it allows us to explore the context of mixed-race Asian American engineering students in great detail [10,16]. However, we were

given the opportunity and interviewed six students. We left engineering broadly defined, or at a minimum within the College of Engineering. Students were given the opportunity to attend the interview over Zoom or in-person with the graduate student researcher on the project.

The student's participation consisted of one 30-60 minute interview with the graduate student researcher. Another aspect that potentially helped with the comfort and ease into the interview was the location of the interview. For this pilot study, students were given the opportunity to have their interview remotely over Zoom or in person at the Asian American Student Center's conference room. This was an explicit choice by the graduate researcher as students may feel more comfortable attending the interview in an environment most comfortable for them. Table 1.0 showcases the demographic background of the six student participants.

Alias	**Major**	**Year**	**Asian (American) Ethnicity**	**Non-Asian Ethnicity**
Nancy	Computer Science	Junior	Chinese (Indonesian nationality)	French Canadian
Josh	Electrical Engineering	Junior	Japanese	Northern European (British)
Brooke	Computer Science	Freshman	Korean	White
Sarah	Computer Science	Freshman	Korean	White (American)
Davis	Computer and Electrical Engineering (double major)	Junior	Quarter Taiwanese	White (American)
Alexander	Electrical Engineering	Freshman	Filipino	Danish

Semi-structured interviews were used which allowed for the interviewing process to be flexible and iterative dependent on the specific student's open-ended responses to close-ended questions [20]. An interview protocol was developed which allowed us to have certain questions to develop the interview, but included various subsections depending on how the student responded to certain questions. Our overall interview protocol consisted of three major categories. The first section of questions were related to introductory demographic and background questions, which helped build repertoire between the graduate researcher and the student participant. Typically, the interview would progress into questions relating to their experiences with engineering and engineering identity. Another section of the interview protocol relied on questions related to being mixed-race. Here, these questions did not clearly specify certain aspects of their mixed-identity but were worded vaguely enough that anyone of mixed identity, not just those included for our study but outside of the mixed-Asian American identity, could respond to. The last

definite section included for our interview protocol focused on questions related to their future and experiences in engineering.

Positionality/Reflexivity

In order to bring our own reflexivity into the research, discussing our positionalities and subsequent biases is important for this pilot study [21]. The first author identifies as a biracial woman of Asian (Korean) and White (European) decent whose lived experiences as a member of the Korean American community of 2.5 generational status (reference to immigrant generation) shapes her interpretations of this pilot study. Working in close proximity to the campus's Asian American student center, as well as volunteering for various Asian American groups has helped her forge relationships with the students, faculty, staff, and community members of the university. However, due to this positionality, further steps in the data analysis stage must be taken to discuss codes and themes with a broader research team. From a critical constructivist standpoint, my perspective guides the research process and data analysis [22].

The second author is an Asian man from China who was educated in both China and the United States. His research focuses on global engineering, engineering ethics, and ethics of AI and robotics.

Findings

Overall, we had three major goals for conducting this exploratory pilot study. First, we wanted to gain a general grasp of factors related to mixed-race identity students found important and salient in describing their experiences and identity. As described in our literature, research on mixed-race students, generally, and in engineering are lacking or nonexistent [4,5]. Second, as this project will be formed into a larger project, we wanted to use this opportunity to explore salient questions and topics related to how students experience being mixed-race in engineering. Third, we are also exploring theoretical frameworks which may be viable for the long-term project. With the specific intersection of mixed-race Asian American students, we utilized questions relating to both Critical Multiracial Theory (MultiCrit) and Asian Critical Theory (AsianCrit) when developing our interview protocol.

Factors of Mixed-Race Identity

For this first round of interviews, aspects commonly discussed in mixed-race identity discourse, such as physical appearance, or not understanding/knowing their Asian ethnic language, were brought up organically by students when describing their experiences being mixed-race. Knowing their specific language, or appearing more Asian than white, were markers that they were different from the typical dominant groups they grew up (most were white except for one international student from Indonesia). Josh cited how his physical appearance doesn't align with his cultural identity:

> I'm a white guy in an Asian body. Which is weird to say but I don't mean it as any

> inappropriate way or anything like that. But it was an identity, like a cultural identity, it would be American. But if it was how I grew up and how I'm perceived in, Japanese. - Josh

As Josh appears to be more Asian looking, he is often perceived by others as fully Asian, but his white identity is rarely acknowledged. Josh's father is of Japanese descent, and Josh's last name is Japanese, thus in-person or on paper, Josh presents as a Japanese person. Similarly, Davis describes how a family friend indicated concern for Davis and his mother during a college campus visit during COVID:

> I went to I went to get on a plane to go to tour a college, I went to go to MIT. And she [family friend, like a grandma figure] literally had to look at me-- and she's White, and she had to look at me and go like, "Be safe," because she had seen so many things of Asian Americans getting hate crimes in airports. And she was literally worried for my mom and I's safety to be like traveling in a situation like that. And I was like-- it was really embarrassing to have to think about that. - Davis

While Davis finds the way that others' perceptions of his physical appearance can be disheartening yet important to his safety, Brooke takes a different approach to the similar problem:

> But being in that half stage is really weird because I'm not American enough to be American, and I'm not Korean enough to be Korean. And it doesn't help that I have both of my Korean passport and American passport. I have both identities. So I have a Social Security number in Korea as well. When I was over there [in South Korea], I had to get my fingerprints down and get my little card and a signature stamp that we have in Korea. And I was like, "Oh, yeah. I kind of forgot I had that." But also when I'm there, they're kind of looking at me like, "Oh, you're not really fully Korean." I'm like, "Yeah, I know that. I know." It's turned more fun nowadays because people do try and guess my ethnic identity, which I think is hilarious because I've gotten answers from all over the world, and it's so funny.

Brooke takes a more lighthearted approach to other's perceptions of her, yet physical appearance becomes an important and undeniable factor of how these students are treated. Physical appearance is one aspect important to understanding the experiences of mixed-race students [34].

While physical appearance is just one factor related to mixed-race identity, we were able to identify some of the major attributes through the interviews. As we gain more participants for this study, we can utilize member checks to ensure that these phenomena are not one-off situations but occur across the student population.

Refinement of Interview Questions

For this study, we looked to previous studies as conducted by Renn [1] and Harris [3] on mixed-race students in higher education. As we were interested in how students would describe their ethnic and racial identity without explicitly being asked, we decided to ask the following question to start the mixed-race discussion: Clarify how you describe yourself? While as social science researchers, we assumed that students might describe their cultural and ethnic backgrounds, we had a mix of descriptions:

> "Relatively easygoing, hardworking. Not much else to it" - Alexander
> "Tall" - Davis
> "I would say relatively smart, I guess, and creative. I do a lot of art-related stuff.." -Sarah
> "Like in general?" -Brooke
> "How would I describe myself just generally or...?" -Josh
> "In what sense?" - Nancy

Overall, students described themselves regarding their appearance, personality, or traits. Others need further clarification of the question. Therefore, we need to formulate another way of asking this question to our participants. Perhaps separating the question into "What is your racial identity?" and "What is your ethnic background?" can help us get to explore the unique and distinct nature of how our participants self-identify in regards to racial and ethnic identity. While we hoped and assumed this question would imply how they identify in relation to their racial or ethnic background, it was very clear that this was not the case. Would students describe themselves as "mixed-race," "biracial," or "multiracial?" Would they first explain their ethnic background? If they described their ethnic backgrounds, which ethnic identity was shared first and in what tone did they describe it? Thus, we need to navigate asking more concise questions without being vague and broad.

Something important to note for future iterations has been the students interests with engineering. When it came to questions about engineering identity, students felt strongly connected to the field of engineering. Students gave a clear and sure (positive) answer about continuing in engineering, when they were prompted about continuing and belonging in engineering. Question about continuing in engineering began to felt redundant. Since many of the students took part in the study due to their excitement about engineering, it seems that they want to be able to share their experiences and are excited about it.

Viability and Testing Theoretical Frameworks: MultiCrit vs. AsianCrit

With this exploratory pilot study, we wanted to test MultiCrit to see if it would be a viable theoretical framework for a larger-scaled project. MultiCrit was developed by Jessica Harris in 2016 to expand the tenets of critical race theory to be applicable for the experiences of mixed-race students in higher education [3]. There are eight overall tenets of MultiCrit. The first is *Challenge to Ahistoricism* which highlights how US historical events are important for viewing multiracial people as a demographic. The second is *Interest Converge*, which focuses on how multiracial students are used by white institutions to advertise and promote a diverse setting, and

not trully having the multiracial students' interests at heart. The third is *Experiential Knowledge*, which centers multiracial students' experiences and narratives as firsthand accounts. The fourth is *Challenge to Dominant Ideology*, which explores how multiracial students challenge dominant white ideologies in white society. The fifth is *Racism, Monoracism, and Colorism*, showcasing how multiracial students can experience and encounter monoracism and colorism for the various racial identity groups they are a part of. The sixth, *A Monoracial Paradigm of Race*, explores how conversations regarding race in the US tend to focus on the black/white binary, despite the exclusion of other racial groups. The seventh, *Differential Micro-racialization,* shows how a students' racialization can be leveraged for different purposes, dependent on the dominant group. The eighth and last tenet of MultiCrit is *Intersections of Multiple Racial Identities* which expands on how multiple racial identities come together along with other various identities such as gender, religion, class, ability, etc.

While our previous work on MultiCrit has found MultiCrit to be used in social sciences fields such as Communications, Education Research, and Developmental Psychology, we believe that MultiCrit could be used for the field of Engineering Education [4,23,24,25,26]. The aim of using MultiCrit for this study is to test several tenets of MultiCrit to examine in depth the experiences of mixed-race Asian American students in engineering and facilitate growth of the framework. For the purposes of this paper, the following five MultiCrit tenets are used to help understand various aspects of identity as mixed-race Asian American experiences in engineering: Experiential Knowledge; Challenge to Dominant Ideology; Racism, Monoracism, and Colorism; A Monoracial Paradigm of Race; and Intersections of Multiple Racial Identities.

Similar to MultiCrit, AsianCrit is the second theoretical framework we wanted to test. Developed out of Critical Race Theory and Asian American Legal Scholarship [27], AsianCrit aims to analyze the ways in which White supremacy, in the United States, has created and formed racism in relation to the Asian American experience [28]. While AsianCrit is an addition to the Critical Race Theory family, it is not meant to replace it but act as an addition to branch out to explore the experiences of Asian Americans in the United States. The aim of using AsianCrit for this study is to test several tenets of AsianCrit to examine in depth the experiences of mixed-race Asian American students in engineering. Yang et al's work suggests and offers utilizing AsianCrit in engineering and STEM education to structurally critique and highlight the challenges unique to Asian and Asian American students face in engineering [29].

AsianCrit has seven tenets [28,29]. *Asianization* examines how people are racialized as "Asian" in the US context as part of whiteness which informs policies, laws, and perspectives mean to exclude and dehumanize Asian Americans. *Transnational Contexts* situate Asian Americans in the larger global context at individual, political, and structural levels. *(Re)constructive history* examines how Asian Americans are rendered invisible in US history and is combatted through creating collective narratives that center Asian Americans. *Strategic (anti)essentialism* recognizes and counters how whiteness has racialized Asian Americans in the US, thus building

on the argument that race is a social construct. *Story, theory, and praxis* centers Asian American experiences as an alternative epistemology grounded in the realities of Asian Americans. *Commitment to Social Justice* advocates to end all forms of oppression and exploitation, including but not explicitly Asian Americans. For the purposes of this study, we use the AsianCrit tenets of Asianization, Intersectionality, and Story, Theory, and Praxis to gain a better understanding of mixed-race Asian American students in engineering.

As we are testing out an exploration of AsianCrit along with MultiCrit in relation to engineering education research, we included an optional section on Asian American identity, if and only if the student brought it up on their own. Depending on time, flow of the interview, and if the student even brought up independently their own Asian American identity, questions were asked regarding their Asian American identity. These questions included asking about the university's environment for Asian Americans, their experiences being Asian American, and if their Asian identity shapes their engineering identity. As all participants indicated being Asian American or (insert ethnic identity) American, all participants were asked these questions.

Regardless of which framework is used for the future of this study, we aim to follow in the footsteps of other engineering education research projects that have utilized critical theories to guide research [30,31,32,33]. We aimed to test tenets from both MultiCrit and AsianCrit in our interview protocol.

Discussion

As the six interviews were completed for our pilot study, the interviewer realized that questions regarding mixed-race identity were not discussed as in-depth as we had expected. There are several speculations behind this phenomenon. First, three of our participants were freshman engineering students. There is a possibility that they have not had the opportunity to explore their mixed-race identity in detail while at college. For instance, they may have not had the opportunity to take a general education required course regarding race, culture, and/or identity. Second, perhaps we need to include greater conversation about what it means to be identified as mixed-race by others and how they perceive their own identity. We need to continue looking at research and interview protocols related to mixed-race identity to determine which questions may be the best to ask our participants. For instance, in the initial round, several students brought up the importance of either their physical traits or language for inclusion in a specific group. Perhaps it would be beneficial to have a list of potential questions to ask if a student brings up appearance in regard to identity. It could also be worth asking students if they have run into situations where faculty or staff have attempted to distinguish their identity. (Do you find professors or peers to ask or question your identity (being perhaps ethnically ambiguous?)

For the future of this study, it may be beneficial to target upperclassmen students as the interviews with freshman students, conducted at the beginning of their second semester on campus, did not go into great depth as they are starting to develop and make sense of their own identity. It is also important to note that while the freshmen students have an idea of what

specific engineering major they want to study, they are unable to formally be recognized in their specific major by the university until they reach sophomore standing and fulfill certain course requirements. It was clear that the juniors interviewed for this project had more to say about their experiences in engineering. However, we were able to build a baseline discussion about the students' upbringing and how that developed their mixed-race identity and other ethnic identities.

One aspect that we want to further explore in future interviews is the notion of code switching in certain situations and engineering spaces. For instance, some students discussed having to act a certain way with one side of the family. Two of our students mentioned that students tend to group themselves in relation to race moreso than gender in engineering and these students were in different majors. It may be interesting to explore code switching and see if this is common among other participants.

Limitations

From the pilot study, we ran into some limitations in regard to the interview process and students recruited for the study. As the researchers were interested in getting an initial set of student interviews, there was no heavy focus on the diversity of the participants. Thus, this set of students happened to be either freshmen (in their first year) or juniors (in their third year) in engineering. We also had an interesting phenomenon in which all six students were in either Computer Science or Electrical/Computer Engineering. For future iterations, we may target other disciplines of engineering, such as biomedical, industrial, and mechanical. Another limitation in regards to our current study population is that all had a mixed-race identity of Asian and white. Again, while this is the majority of the demographic making up mixed-race Asian Americans, we hope to include further diverse mixed-race narratives of various racial make-ups.

Conclusion

Overall, this small scale pilot study helped us determine several future directions for the feasibility of this project. First, we were able to identify some factors important to exploring mixed-race identity of engineering students. Second, we were able to test and engage questions with students which will be expanded on in the next iteration of this project. Third, we were able to view how both MultiCrit and AsianCrit could be used and applied in future engineering education research. Both could also be utilized for the future of this project, yet it is important to realize the heart of this project is focused on mixed-race identity. In some ways, looking at MultiCrit has helped explain some features of a mixed-race student's experience in engineering education. However, most of those experiences could also be generalized to the environment of higher education. AsianCrit could also be useful for the future of this project due to the connections of racialization and experiences in the United States of being Asian American. Yet, if we were to only use AsianCrit, this project becomes an entirely different one than originally envisioned. In the next iteration of this study, we aim to focus, more so, on questions related to the intersection of engineering and mixed-race identity. While there is a lot of information power

separately, getting to the nitty-gritty of the intersection between MultiCrit and AsianCrit has proven to be difficult, yet an exciting task to be taken head-on.

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